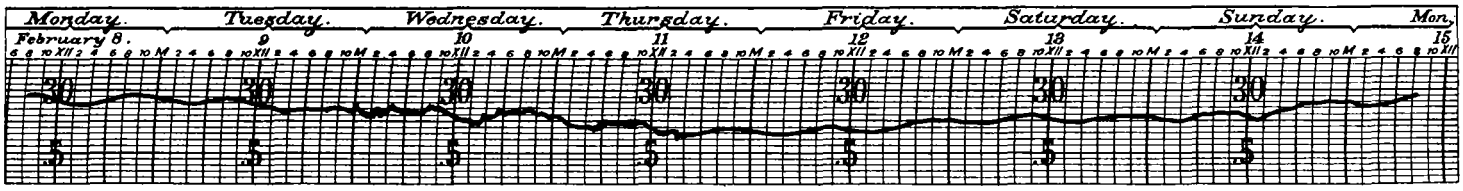

FIG. 1.

was a steady, slow fall of barometric pressure, amounting to 0.25 inch, if we compare only the readings at 9 a. m. During the last three days pressure rose slowly by 0.26 inch from 9 a. m. of the 12th to the 15th. It does not necessarily follow that Honolulu was on the outskirts of a moving hurricane or typhoon. To decide that question, one must have the wind records. It is equally possible that we here have to do with a slow oscillation of the location of the general area of tropical high pressure northeast of Honolulu or of equatorial low pressure south of Honolulu. Evidently the word "storms," as used by Mr. Lydecker, refers only to rainfall, as there was neither high wind nor rapid changes in barometric pressure. There can hardly be any doubt but that under these circumstances the rainfall represents the result of changes going on in wind, moisture, and temperature in the cloudy layer and the higher regions of the atmosphere; changes that are due to slight and widespread changes in atmospheric pressure. Similar changes occur within the regions of our own daily weather maps. A fall of a tenth of an inch in pressure, or less, in the equatorial regions, as shown by reports from Colon, the West Indies, or Mexico, is likely to be at once followed by a cold wave spreading from Canada southward over the Valley of the Mississippi. Before the front of the cold wave reaches the Gulf of Mexico rain and snow are likely to occur, and as soon as it reaches the warm waters of the Gulf they are certain to occur. The atmosphere is so mobile, or, in other words, viscosity is so small a factor, that slight gradients of pressure, not always recognizable on our present meteorological maps, quickly set it in motion. The resistances introduced by the irregularities of the ground may require a slight additional gradient to overcome them, but in a general way the progress of a cold wave toward the Gulf of Mexico, like the progress of the great monsoon wind from the southern Indian Ocean across the equator to the shores of Hindostan, is maintained by a slight gradient entirely different from the steep gradients that prevail within a whirlwind. Therefore it is that a fall of a tenth of an inch in twenty-four hours is an important matter and almost certainly a forerunner of rain in India, the West Indies, Honolulu, and the Philippines. These all represent moist climates at about 20° north latitude, where the ascent of the air to the extent of a few thousand feet cools it sufficiently to produce cloud and rain.

Those who wish to make a minute study of the fluctuations shown on the accompanying facsimile of the Honolulu barogram (fig. 1) may correct it for slight deviations from the readings of the standard mercurial barometer by means of the following table of corrections furnished by Mr. Lydecker:

Time.*	Standard pressure.†	Correction to barogram.‡
February 8, 9 a. m.	29.95	0.00
February 9, 9 a. m.	29.93	0.00
February 10, 9 a. m.	29.83	−0.03
February 11, 9 a. m.	29.70	−0.04
February 12, 9 a. m.	29.68	−0.02
February 13, 9 a. m.	29.77	−0.01
February 14, 9 a. m.	29.79	−0.01
February 15, 9 a. m.	29.94	0.00

*Honolulu date and standard time, 157° 30′. †Reading of standard mercurial barometer at 9 a. m., reduced to standard temperature, sea level, and gravity. ‡Correction to be applied to the readings of the barometer in order to obtain standard pressures.

C. A.

DUST IN THE ATMOSPHERE DURING 1902-3.

By ANDREW NOBLE, Esq., Rozelle, Sydney, N. S. W. Dated July 16, 1904.

I have been much interested in the recent notices that have appeared relative to a diminution in the transparency of the earth's atmosphere during 1902–3, and more particularly in the article that appeared at page 111 of the MONTHLY WEATHER REVIEW for March, 1904, and, in response to the request of the Editor, published in Nature, vol. 70, May 19, 1904, at page 60, I have gone through my notes and scrapbook in order to collect any matter that may be of service to him. Duststorms were characteristic of the late 9-years' drought in Australia, especially during the latter stages. It is difficult to give an adequate idea of the effect produced by these dust or sand storms. The soil, made loose and friable by the prolonged absence of rain, no longer able to withstand the wind, was swirled up and carried across country with resistless force. In many cases it was torn up to a depth of one foot, or down to solid clay. On a station in the Wileaunia district 100,000 acres were left as bare as a floor, upon which a heavy rain that followed had no effect. In one case 12 feet of sand were deposited in a bank in three months. Wherever a little resistance offered, the sand accumulated, and eventually formed a dune. Wire-netted rabbit-proof fences were buried in this way, and even a second story to the fence shared a similar fate. On the Albemarle station (latitude 32° 13′, longitude 142° 40′) a 7-foot stock yard fence was so completely submerged within eighteen months of erection that the owner drove over it in his buggy. Numerous instances are given of daylight becoming completely obscured during the progress of these storms, and, in consequence, lamps had to be lit. All traffic stopped; people lost their way, not being able to see their hands when held up before their faces; and fowls went to roost in the daytime. Although intermittent during the winter months of 1902, these storms renewed their activity much earlier than usual during the following spring. Early in September, 1902, the ship *Wakatipu* encountered in Bass Straits a rain squall accompanied by a "fall of fine chocolate mud." The wind was west-southwest at the time. The early return of these storms during 1902 was undoubtedly due to the intensified character of the drought in central Australia during the antecedent six months. Referring to this period, Sir Charles Todd writes:

> During the past winter the six months rainfall (April to September) at 37 selected stations in South Australia is, without exception, far below the average amount. It is, in fact, one of the driest years ever experienced. So far as all the northern areas are concerned, it is the driest, and the same applies to many parts of the south. At 24 out of 37 stations the winter of 1902 is the driest on record, while at 8 others only one other year was drier.

It is in this part of Australia that our duststorms have their origin. Sturt, the explorer, in his diary writes:

> North and northwest of Flinders Range are large plains, extending as far as latitude 25°. To the north of that latitude, though the sun was intensly hot, there were no hot winds; in fact from that parallel of latitude to the Indian Ocean, either going or coming, they were not met with. On reaching latitude 27° on my return, I found the hot winds prevailing again, as on my outward journey. I saw no sandy desert, to which these hot winds had been attributed, but on lifting some of the stones that were lying on the surface I found them so hot that I was obliged to drop them immediately. It is my opinion that when a hot wind blows across these stone-covered plains it collects the heat from them, and the air becoming rarified is driven on southward with increased vehemence.

Mr. Auld, in the Adelaide Advertiser, of December 20, 1862, confirms this experience, and writes:

The hottest weather experienced by the exploration party was within or near the boundaries of South Australia, and they never experienced a hot wind in the interior.

Following the unprecedentedly dry winter of 1902, these storms became more pronounced during the spring months, and continued with varying intensity according as the wind circulation of passing atmospheric depressions favored their formation and distribution. They undoubtedly attained their culmination in the great storm of November 11 to 13, 1902. This storm assumed a phenomenal character, especially in South Australia, Queensland, New South Wales, and Victoria. In the latter State the effect was extraordinary on the 12th, the majority of stations reporting gales of dust accompanied by lightning, balls of fire, and darkness in the daytime so intense that fowls went to roost in the afternoon, while people had to find their way about by the aid of lanterns. The ship *Airlie*, en route from Brisbane to Sydney, 13th to 15th of November, encountered a duststorm, the dust covering the ship from end to end. Several passing vessels experienced showers of the so-called red rain. Mr. H. Stuart Dove, of West Devonport, Tasmania, writes:

On November 12 I noticed that the sky to the north and northeast, from horizon halfway up to zenith, had assumed an extraordinary chocolate-brown tint, due to clouds of that color which were moving toward us from the northwest. Under these clouds and moving from the northeast were ashy-gray patches of strata, streaked with fantastic dark lines resembling bows and boomerangs. A few drops of rain which fell about 5 p. m. were charged with brown, earthy matter, and at 6 p. m. a paper which was held in the rain became spotted all over with blotches. At 6:20 p. m. the solid matter was still descending, but in less quantity. At 6:30 there was a marked diminution, and by 6:50 p. m. the rain was all but free from it.

In Nature, Vol. LXVIII, July, 1903, p. 223, P. Marshall, of Otago University, New Zealand, supplies an interesting account of a heavy dust fall and storms in various parts of that colony on November 14 and 15, which, he states, were not due to local causes, and he shows by microscopical and chemical examination of the dust and by the distribution of atmospheric pressure and resultant winds between Australia and New Zealand that the dust was probably transported from Australia over the 1200 miles of intervening ocean.

On November 15, 1902, Mr. Langdon, superintendent of the Eastern Extension Telegraph Company, Port Darwin, Australia, received the following cablegram from Banjoewangie:

Very hazy last few days; temperature high; wind variable from south to northwest. Sourabaya papers last week reported a heavy haze in the Java Sea, lying low on the water, supposed to be due to volcanic dust from Martinique. No eruption in Java, but on the 12th, between 4:30 and 5 p. m. (local time), a short, heavy shock of earthquake was felt at Zoenadjang, Malay, and Banjoewangie, direction east to west, attributed to the Sinero.

On November 17, 1902, the postmaster at Port Darwin sent the following message to Sir Charles Todd:

Color of haze or smoke, bluish gray. Slight shower of rain on 15th. Blaeser, of this department, took a clean sheet of glass and exposed it to the rain, allowing the rain water from the glass to run into a small, clean bottle. The rain water in bottle contains sediment of light, fluffy dust; color, gray. Haze very prevalent yesterday; also continues to-day, but not so dense as on Friday (i. e., 14th).

Captain Dabelle, of the steamer *Guthrie*, upon arrival at Port Darwin on November 16, 1902, reported that the steamer was delayed by difficulty in picking up the land, owing to the prevalence of the smoke which was encountered all the way between the Philippine Islands and Australia. The captain said that the smoke was unlike that from bush fires. On November 16 it was so thick that the bold headlands on North Australia at a distance of one mile were completely obscured. The haze could be plainly seen between clumps of trees, houses, and other objects less than 200 yards away.

Capt. C. Lindburgh, of the steamer *Tsinan*, upon arrival at Port Darwin on November 24, 1902, supplied extracts from the ship's log during the last voyage northward from Port Darwin to Honkong, and on his return passage from Hongkong to Port Darwin again. These show that a thick haze was experienced from October 17 to 21. During this time the officers never saw land and had trouble in getting observations. The captain reported the hazy weather on arrival at Hongkong, where it was supposed to be caused by volcanoes in Sumatra. It lasted from latitude 8° 16′ south, longitude 129° east, to latitude 6° 34′ north, longitude 123° 22′ east. The barometer ranged from 30.14 to 30.00. On his return trip the haze commenced in latitude 1° 18′ south, longitude 125° 27′ east, and lasted until arrival in port. The phenomenon was generally considered to be due to volcanic disturbances.

The above notes show that the duststorm of November 11 to 13, 1902, involved the greater part of Australia and the surrounding ocean, at least as far as New Zealand. From this epoch they gradually lost their intensity and general character, at least so far as the whole of Australia is concerned, although they continued to be severe over interior parts of New South Wales up to the spring of 1903. They probably received a check by the widespread and useful rains which fell during the middle of February, 1903. These were largely due to an antarctic disturbance, and they spread over central Australia and the whole of Victoria, the falls registered ranging up to over two inches. This disturbance brought abnormally cold conditions for the time of the year. In Adelaide the 14th was, with one exception, the coldest day ever experienced in February, the maximum shade temperature being 64.8°. On February 19, 1883, it was one degree lower. A heavy fall of snow took place at Kiandra, N. S. W., on February 15, accompanied by a high wind from northwest, the temperature falling to 35°.

STORM OF AUGUST 20, 1904, IN MINNESOTA.

By T. S. OUTRAM, Local Forecaster, Minneapolis, Minn.

In Minneapolis, on the day in question, the sky was cloudy from about 8 a. m. until 5 p. m., when it cleared; but before 7 p. m. it clouded up again rapidly from the south with clouds which seemed at first to be somewhat high. These clouds had a rather greenish-yellow cast, and soon after 8 p. m. the whole sky was overcast and very stormy looking, a few persons saying that they saw many clouds of a pendulous shape, though no one has reported seeing anything that in any way resembled a tornado funnel. Light rain fell at intervals from 8:25 to 9:11 p. m., when it became excessive. During the period of excessive rainfall—from 9:11 to 9:56 p. m.—1.10 inches were recorded. It is not possible that the gage could have received the total amount of rainfall, as the sheets of rain, driven by the gale, must have fallen in a direction almost parallel with the top of the gage. Torrents of rain filled the streets with floods of water from curb to curb to a depth of 6 inches for probably ten minutes on grades which were steep enough to carry the water with a rapid current. At the station there were a few small hailstones for a minute or so, shortly before the heavy rain began, but in other parts of the city and in some parts of the country the fall of hail is said to have been heavy.

The self-register at the station shows the wind direction to have been north and northwest after noon; at 1:15 p. m. it became northeast; at 2:40 p. m., east; at 9:15 p. m., northeast; at 9:35 p. m., east; at 9:38 p. m., west; at 9:39 p. m., southeast; at 9:44 p. m., northeast; at 9:45 p. m., north; at 9:46 p. m., northwest; at 10:05 p. m., north; at 10:17 p. m., northeast; after which time the velocity was reduced to fresh. The velocities recorded by the anemometer were as follows: After about 3 p. m. the velocity was fresh; from 9:35 to 9:40 p. m. it was 45 miles per hour; from 9:40 to 9:45 p. m. it was 60 miles per hour; from 9:45 to 9:50 p. m. it was 84 miles per hour, with an extreme velocity of 110 miles per hour about